

**Claims**

1. A gas barrier packaging laminate (10) having durability to stress crack formation and yet a bending stiffness and good integrity between the laminate layers, comprising:
  - 5 outside layers of heat-sealable olefin polymer (16, 17);
  - a first gas barrier layer of SiO<sub>x</sub> (13) coated onto a first polymer carrier layer (11);
  - 10 a second gas barrier layer of SiO<sub>x</sub> (14) coated onto a second polymer carrier layer (12); and
  - an intermediate polymer layer (15) laminated between the first and the second gas barrier coated polymer carrier layers,
    - 15 wherein the intermediate polymer layer includes a thermoplastic polymer with high elastomeric properties and wherein a stiffness of each of the first and second polymer carrier layers interacts with a thickness of the intermediate polymer as a shock absorbing, distancing layer in a structural sandwich construction, to provide the durability to stress-cracking, bending stiffness and good integrity between the layers.
- 20 2. The gas barrier packaging laminate according to claim 1, wherein the durability to stress-cracking, bending stiffness and integrity between the layers renders the packaging laminate suitable for packaging of liquid foods and drinks by a high speed, continuous process.
- 25 3. The gas barrier packaging laminate according to claim 1, wherein the thickness of the intermediate layer (15) is from 30 to 55% of a total thickness of the packaging laminate (10).
- 30 4. The gas barrier packaging laminate according to claim 3, wherein the thickness of the intermediate layer (15) is from 35 to 50% of the total thickness of the packaging laminate (10).

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5. The gas barrier packaging laminate according to claim 1, wherein a thickness of the first polymer carrier layer (11) or a thickness of the second polymer carrier layer (12) is from 5 to 20 % of a total thickness of the packaging laminate (10).

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6. The gas barrier packaging laminate according to claim 5, wherein the thickness of the first polymer carrier layer (11) or the thickness of the second polymer carrier layer (12) is from 5 to 15 % of the total thickness of the packaging laminate (10).

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7. The gas barrier packaging laminate according to claim 1, wherein the first polymer carrier layer (11) or the second polymer carrier layer (12) is a film of polyester, polyamide or polypropylene or a multilayer film comprising a substrate surface layer of one of said polymers.

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8. The gas barrier packaging laminate according to claim 1, wherein the first polymer carrier layer (11) or the second polymer carrier layer (12) is a film of a polymer selected from the group consisting of mono- or biaxially oriented polyethyleneterephthalate (PET), mono- or biaxially oriented polyethylenenaphthalate (PEN), mono- or biaxially oriented polyamide (PA) and mono- or biaxially oriented polypropylene or a multilayer film comprising at least one oriented layer of one of said polymers.

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9. The gas barrier packaging laminate according to claim 1, wherein the thermoplastic polymer with high elastomeric properties of the intermediate layer (15) is selected from the group consisting of very low density polyethylene, ultra low density polyethylene, polyethylene copolymers, polyethylene terpolymers, polyolefin-based elastomers and plastomers, and a blend of very low density polyethylene or ultra low density polyethylene with another polyolefin.

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10. The gas barrier packaging laminate according to claim 1, wherein the thermoplastic polymer with high elastomeric properties of the intermediate layer

(15) includes very low density polyethylene and a polymer of the first polymer carrier layer (11) and a polymer of the second polymer carrier layer (12) include an oriented polyester or polyamide.

5 11. The gas barrier packaging laminate according to claim 1, wherein the first gas barrier layer of SiO<sub>x</sub> (13) and the second gas barrier layer of SiO<sub>x</sub> (14) are positioned in the laminate facing towards each other.

10 12. The gas barrier packaging laminate according to claim 1, wherein the first gas barrier layer of SiO<sub>x</sub> (13) and the second gas barrier layer of SiO<sub>x</sub> (14) are deposited by PECVD technique at a thickness of from 50 to 500 Å, and wherein x=1.7-2.0.

15 13. The gas barrier packaging laminate according to claim 12, wherein the thickness is from 80 to 300 Å.

14. The gas barrier packaging laminate according to claim 1, wherein a thickness of the first polymer carrier layer (11) or a thickness of the second polymer carrier layer (12) is from 7 to 30 µm.

20 15. The gas barrier packaging laminate according to claim 14, wherein the thickness of the first polymer carrier layer (11) or the thickness of the second polymer carrier layer (12) is from 8 to 20 µm.

25 16. The gas barrier packaging laminate according to claim 15, wherein the thickness of the first polymer carrier layer (11) or the thickness of the second polymer carrier layer (12) is from 8 to 15 µm.

17. The gas barrier packaging laminate according to claim 1, wherein the 30 first polymer carrier layer (11) and the second polymer carrier layer (12) have the same thickness.

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18. The gas barrier packaging laminate according claim 1, wherein the thickness of the intermediate layer (15) is from 30 to 80  $\mu\text{m}$ .

19. The gas barrier packaging laminate according claim 18, wherein the 5 thickness of the intermediate layer (15) is from 35 to 65  $\mu\text{m}$ .

20. The gas barrier packaging laminate according claim 19, wherein the thickness of the intermediate layer (15) is from 40 to 65  $\mu\text{m}$ .

10 21. The gas barrier packaging laminate according to claim 1, wherein a total thickness of the packaging laminate is from 100 to 180  $\mu\text{m}$ .

22. The gas barrier packaging laminate according to claim 21, wherein the total thickness of the packaging laminate is from 100 to 150  $\mu\text{m}$ .

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23. The gas barrier packaging laminate according to claim 1, wherein the thickness of the intermediate layer (15) is from 35 to 65  $\mu\text{m}$ , a thickness of the first polymer carrier layer (11) or a thickness of the second polymer carrier layer (12) is from 8 to 15  $\mu\text{m}$ , a thickness of the outside layers of heat-sealable olefin polymer 20 (16,17) is from 10 to 25  $\mu\text{m}$  and from 18 to 30  $\mu\text{m}$ , respectively, and a total thickness of the packaging laminate is from 100 to 150  $\mu\text{m}$ .

24. The gas barrier packaging laminate according to claim 23, wherein the thickness of the intermediate layer (15) is from 40 to 65  $\mu\text{m}$  and the thickness of 25 the first polymer carrier layer (11) or the thickness of the second polymer carrier layer (12) is from 12 to 15  $\mu\text{m}$ .

25. The gas barrier packaging laminate according to claim 23, wherein the thickness of the intermediate layer (15) is from 40 to 65  $\mu\text{m}$  and the thickness of 30 the first polymer carrier layer (11) or the thickness of the second polymer carrier layer (12) is from 8 to 12  $\mu\text{m}$ .

26. The gas barrier packaging laminate according to claim 1, wherein the intermediate polymer layer (15) is laminated to the adjacent layers of SiO<sub>x</sub> (13,14) by means of a binder layer (18,19).

5 27. The gas barrier packaging laminate according to claim 26, wherein the binder layer (18,19) comprises a blend of a graft copolymer of alkoxysilane and polyethylene with a non-grafted polyethylene.

10 28. The gas barrier packaging laminate according to claim 1, wherein the laminate is transparent.

29. A packaging container manufactured from the packaging laminate according to claim 1.

15 30. A method of manufacturing of a packaging laminate including outside layers of heat-sealable olefin polymer (16, 17), a first gas barrier layer of SiO<sub>x</sub> (13) coated onto a first polymer carrier layer (11), a second gas barrier layer of SiO<sub>x</sub> (14) coated onto a second polymer carrier layer (12); and an intermediate polymer layer (15) of a thermoplastic polymer having high elastomeric properties 20 laminated between the first and the second gas barrier coated polymer carrier layers, the method comprising the steps of:

25 advancing a first web (331) and a second web (334) towards each other and towards a first extrusion station (337), the first web (331) comprising a first polymer carrier layer (332) coated with a first SiO<sub>x</sub> gas barrier layer (333) and the second web (334) comprising a second polymer carrier layer (335) coated with a second SiO<sub>x</sub> gas barrier layer (336);

30 laminating the first web (331) and the second web (334) to each other by means of extruding an intermediate polymer layer (338), optionally together with a binder layer (339) on each side of the intermediate polymer layer (338), between the first web and the second web and pressing the first web and the second web together at the first extrusion station (337);

extruding a first outside layer (342) onto the outside of the first or second polymer carrier layer (332 or 335) at a second extrusion station 341, the first outside layer (342) comprising a heat-sealable polyolefin; and

5 extruding a second opposite outside layer (345) onto the outside of the other of the second or first polymer carrier layer (335 or 332) at a third extrusion station 344, the second opposite outside layer (345) comprising a heat-sealable polyolefin.

10 31. The method according to claim 30, wherein the first web (331) and the second web (334) are advanced towards each other such that the SiO<sub>x</sub> gas barrier layers (333, 336) are facing each other.

15 32. The method according to claim 30, wherein the first SiO<sub>x</sub> gas barrier layer (333) and the second SiO<sub>x</sub> gas barrier layer (336) are treated by a surface activation treatment before laminating.

33. The method according to claim 32, wherein the a surface activation treatment is corona treatment.

20 34. A method of manufacturing of a packaging laminate including outside layers of heat-sealable olefin polymer (16, 17), a first gas barrier layer of SiO<sub>x</sub> (13) coated onto a first polymer carrier layer (11), a second gas barrier layer of SiO<sub>x</sub> (14) coated onto a second polymer carrier layer (12); and an intermediate polymer layer (15) of a thermoplastic polymer having high elastomeric properties laminated between the first and the second gas barrier coated polymer carrier layers, 25 the method comprising the steps of:

30 advancing a first web (331) and a second web (334) towards each other and towards a first extrusion station (337), the first web (331) comprising a first polymer carrier layer (332) coated with a first SiO<sub>x</sub> gas barrier layer (333) and the second web (334) comprising a second polymer carrier layer (335) coated with a second SiO<sub>x</sub> gas barrier layer (336);

laminating the first web (331) and the second web (334) to each other by means of extruding an intermediate polymer layer (338), optionally together with a

binder layer (339) on each side of the intermediate polymer layer (338), between the first web and the second web and pressing them together at the extrusion station (337);

5 laminating by application of heat and pressure at a first hot roller nip (341') a first premanufactured film (342') to the outside of the first or second polymer carrier layer (332 or 335), the first premanufactured film (342') comprising at least one layer of a heat-sealable polyolefin; and

10 laminating by application of heat and pressure at a second hot roller nip (344') a second premanufactured film (345') to the outside of the other of the second or first polymer carrier layer (335 or 332), the second premanufactured film (345') comprising at least one layer of a heat-sealable polyolefin.

15 35. The method according to claim 34, wherein the first web (331) and the second web (334) are advanced towards each other such that the SiO<sub>x</sub> gas barrier layers (333, 336) are facing each other.

20 36. The method according to claim 34, wherein the first SiO<sub>x</sub> gas barrier layer (333) and the second SiO<sub>x</sub> gas barrier layer (336) are treated by a surface activation treatment before laminating.

37. The method according to claim 36, wherein the surface activation treatment is corona treatment.

25 38. A method of manufacturing of a packaging laminate including outside layers of heat-sealable olefin polymer (16, 17), a first gas barrier layer of SiO<sub>x</sub> (13) coated onto a first polymer carrier layer (11), a second gas barrier layer of SiO<sub>x</sub> (14) coated onto a second polymer carrier layer (12); and an intermediate polymer layer (15) of a soft and/or elastomeric polymer laminated between the first and the second gas barrier coated polymer carrier layers, the method comprising the 30 steps of:

advancing a first web (331) and a second web (334) towards each other and towards a first hot roller nip (337), the first web (331) comprising a first polymer

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carrier layer (332) coated with a first SiO<sub>x</sub> gas barrier layer (333) and the second web (334) comprising a second polymer carrier layer (335) coated with a second SiO<sub>x</sub> gas barrier layer (336);

5       laminating the first web (331) and the second web (334) to an intermediate pre-manufactured web (338') by advancing the intermediate pre-manufactured web (338') between the first web (331) and second web (334) and applying heat and pressure in the first hot roller nip (337'), the intermediate pre-manufactured web (338') comprising an intermediate polymer layer (338') and, optionally, a binder layer (339') on each side of the intermediate polymer layer (338');

10       laminating by application of heat and pressure at a second hot roller nip (341') a first premanufactured film (342') to the outside of the first or second polymer carrier layer (332 or 335), the first premanufactured film (342') comprising at least one layer of a heat-sealable polyolefin; and

15       laminating by application of heat and pressure at a third hot roller nip (344') a second premanufactured film (345') to the outside of the other of the second or first polymer carrier layer (335 or 332), the second premanufactured film (345') comprising at least one layer of a heat-sealable polyolefin.

39.       The method according to claim 38, wherein the first web (331) and 20 the second web (334) are advanced towards each other such that the SiO<sub>x</sub> gas barrier layers (333, 336) are facing each other.

40.       The method according to claim 38, wherein the first SiO<sub>x</sub> gas barrier layer (333) and the second SiO<sub>x</sub> gas barrier layer (336) are treated by a surface 25 activation treatment before laminating

41.       The method according to claim 40, wherein the surface activation treatment is corona treatment.